

# Vermont Department of Health **Vermont Fish Mercury Report**

## Mercury Concentrations in Vermont Fish & Basis for Safe Fish-Eating Guidelines

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## Executive Summary

This report describes the basis for the Vermont Department of Health (Health) Safe Fish-Eating Guidelines for sport-caught fish. The fish mercury concentrations and Safe Fish-Eating Guidelines for commonly caught fish species are presented with clear advice that encourages Vermonters to eat healthy fish that are low in mercury. The safe fish-eating guidelines emphasize the message “Eat fish, choose wisely”, and provide the recommended number of meals per month for each species of Vermont fish, to get the benefits of eating fish while limiting mercury exposure.

## Introduction

Nearly all fish contain traces of mercury, no matter what body of water they come from. All fifty states have issued advisories to protect people from potential health risks of eating contaminated fish caught in local waters.<sup>1</sup> Safe eating guidelines assist fish consumers in making decisions about their own mercury exposure to balance the benefits and risks of eating sport-caught fish (Scherer et al., 2008). The United States Environmental Protection Agency (EPA) encourages states to issue safe eating guidelines based on data from fish that have been tested for chemical contamination and are found to be safe to eat.

Fish that you catch can be part of a healthy balanced diet. Fish are good source of protein, vitamins and minerals and are the primary food source for essential omega-3 fats.<sup>2</sup> The US Department of Health and Human Services and the Department of Agriculture joint Dietary Guidelines encourage people who may become pregnant to consume at least eight ounces of a variety fish week from choices that are lower in mercury and higher in omega-3 fats.<sup>3</sup> Modern risk communication techniques emphasize the benefits of eating fish, include pictures of commonly consumed fish species, and use simple advice categories (Tan et al., 2011, Gray et al., 2021).

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<sup>1</sup>US EPA Fish and Shellfish Advisories and Safe Eating Guidelines  
<https://www.epa.gov/choose-fish-and-shellfish-wisely/fish-and-shellfish-advisories-and-safe-eating-guidelines>

<sup>2</sup> National Institute of Health Omega-3 Fatty Acids Fact Sheet for Health Professionals  
<https://ods.od.nih.gov/factsheets/Omega3FattyAcids-HealthProfessional/#:~:text=The%20omega%2D3%20content%20of,contain%20lower%20levels%20%5B3%5D>

<sup>3</sup> Scientific Report of the 2020 Dietary Guidelines Advisory Committee  
[https://www.dietaryguidelines.gov/sites/default/files/2020-07/ScientificReport\\_of\\_the\\_2020DietaryGuidelinesAdvisoryCommittee\\_first-print.pdf](https://www.dietaryguidelines.gov/sites/default/files/2020-07/ScientificReport_of_the_2020DietaryGuidelinesAdvisoryCommittee_first-print.pdf)

Warnings about mercury in fish have caused some people to avoid eating fish entirely, eliminating an important dietary source of protein and nutrients (Krabbenhoft et al., 2019). Recent mercury fish-risk communications have advanced with the goal of promoting the health benefits from eating freshwater fish, while clarifying which fish to avoid. Vermont freshwater fish are a sustainable local-sourced food and many species have low mercury concentrations when compared to some fish at the supermarket. To communicate the Vermont Safe Fish-Eating Guidelines Health has produced a Fish Card with mercury-based recommended meal limits for both the Fish You Catch and the Fish You Buy.

The Vermont Fish Contaminant Monitoring Committee (FCMC), is composed of scientists from the Vermont Department of Fish & Wildlife, Department of Environmental Conservation (DEC) and Health. The FCMC reviews all available Vermont fish contaminant information: data are obtained from fish studies conducted by EPA, the Vermont Agency for Natural Resources, and the Lake Champlain Basin Program<sup>4</sup>. Health uses the fish contaminant data from the FCMC to establish Safe Fish-Eating Guidelines using the same risk assessment approach used by other states and the EPA. This report contains the Vermont fish mercury concentrations that are the basis for the Vermont Safe Fish-Eating Guidelines, and the methods used to determine the recommended meals per month.

## Contaminants in Vermont Fish

All fish have detectable levels of mercury. Some freshwater fish contain contaminants in addition to mercury including other metals, polychlorinated biphenyl compounds (PCBs), pesticides and per and polyfluorinated alkyl substances. These fish contaminants have been investigated on a site-specific basis in places where contamination is known or suspected. The waterbody-specific fish PCB advisories for

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<sup>4</sup> Facts About Mercury and PCBs in Lake Champlain <https://www.lcbp.org/wp-content/uploads/2013/03/MercuryPCBFactSheet1.pdf>

Vermont are discussed under Waterbody-Specific Advisories. Other fish contaminants were evaluated in the Lake Memphremagog brown bullhead investigation<sup>5</sup>: and the Vermont PFAS in Surface Water and Fish Tissue Monitoring reports.<sup>6</sup>

### **Vermont Safe Fish-Eating Guidelines are Based on Mercury**

- **Mercury is in all fish**
- **Mercury levels have been measured in Vermont fish**
- **Mercury levels in some fish can present a health risk**

The National Lake Fish Tissue Study EPA investigated fish fillet levels of mercury, PCBs, PAHs pesticides, PFAS and other contaminants, and mercury was found to be the most common fish contaminant to exceed health-based criteria. <sup>7</sup> More recently EPA's National Rivers and Streams Assessment (Stahl et al., 2023) presented a comprehensive characterization of mercury, PCB, and PFAS fish fillet tissue from rivers and streams. Again, in U.S. rivers and streams, mercury is the most prevalent fish tissue contaminant to present a health risk. Following the recommended fish meal limits based on mercury will also decrease exposure to other contaminants that might be present in Vermont fish.

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<sup>5</sup> Scientists hope genetics could tell them why these catfish in Lake Memphremagog have a rare cancer . Vermont Public <https://www.nhpr.org/2023-09-13/brown-bullhead-fish-cancer-melanoma-lake-memphremagog-vermont-genetics-research>

<sup>6</sup> Vermont PFAS in Surface Waters <https://dec.vermont.gov/watershed/tasc/pfas-surface-waters>

<sup>7</sup> National Study of Chemical Residues in Lake Fish Tissue <https://www.epa.gov/sites/default/files/2018-11/documents/national-study-chemical-residues-lake-fish-tissue.pdf>

## Mercury in the Environment

Mercury is an element, and it does not break down in the environment. Mercury may be released to the environment from natural or man-made sources in its elemental form, as an inorganic salt, or in an organic form. Atmospheric emissions of inorganic mercury can enter the environment through deposition onto soil and water. Inorganic mercury in the environment can be transformed into a more toxic organic form, methylmercury. Methylmercury can bioaccumulate in the food chain resulting in higher concentrations in predatory fish species such as bass and walleye. Most of the mercury in fish is in the form of methylmercury, however the laboratory analysis is for total mercury, so the results are reported in terms of inorganic mercury, referred to simply as mercury.

## Fish Mercury Data Analysis

### Mercury Dataset for Safe Fish-Eating Guidelines

All available Vermont fish mercury data were gathered for this analysis: this includes the data used for the 2013 fish consumption advisory, and an additional sampling by the Lake Champlain Project in 2017. Fish mercury concentrations are available from the years 1993 through 2017. The current dataset is limited in that no laboratory or field records are available for most samples. Certain data was excluded from the dataset as described in the sections to follow.

### Exclusion of Data from Waterbodies with Specific Advice

Research over the last four decades has demonstrated that fish in some reservoirs can have elevated mercury concentrations compared to those from rivers and natural lakes (Hsu-Kim et al., 2018, Mailman et al., 2005). Mercury deposition and its transformation

to methylmercury within waterbodies is complex, but it is known that reservoirs with manipulated water levels show higher levels of mercury methylation (DEC 2020).<sup>8</sup> In addition to increased mercury production following the initial flooding, the ongoing operations can continue to affect methylmercury production in older reservoirs (Orem et al. 2011; Eckley et al. 2015). Vermont has two reservoir systems that are specifically listed for fish mercury contamination on the EPA's 303(d) List of Impaired Waters:<sup>9</sup>

- The Deerfield River Watershed (Grout Pond, Somerset Reservoir, Harriman Reservoir, Sherman Reservoir, and Searsburg Reservoir).
- The Connecticut River Fifteen-Mile Falls, located in Grafton County, New Hampshire and Caledonia County, Vermont, is comprised of the Moore, Comerford, and McIndoes Reservoirs.

The unique mercury bioaccumulation dynamics that occur in reservoirs necessitates a specific advisory for fish from some reservoirs (Wentz et al., 2014). Therefore, fish from the Connecticut River Reservoirs and the Deerfield Chain were excluded from the dataset used for the statewide advisory. The fish mercury data from these reservoirs and waterbody-specific advisories are presented in the Waterbody-Specific Advisory section of this report.

## Exclusion of Fish Smaller than Harvest Limits

Of 1,458 samples, four samples lacked length information (one rainbow smelt, one walleye and two lake trout) and 72 samples were smaller than harvest limits. These 76 samples were excluded from the advisory dataset (summary presented in Appendix 1).

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<sup>8</sup> Deerfield River Tactical Basin Plan - 2020

<https://dec.vermont.gov/sites/dec/files/WID/WPP/Deerfield%20River%20Tactical%20Basin%20Plan%20-%202020.pdf>

<sup>9</sup> State of Vermont 2020 303(d) List of Impaired Waters Part A - Impaired Surface Waters in Need of TMDL [https://dec.vermont.gov/sites/dec/files/documents/mp\\_PriorityWatersList\\_PartA\\_303d\\_2020.pdf](https://dec.vermont.gov/sites/dec/files/documents/mp_PriorityWatersList_PartA_303d_2020.pdf)



## Summary of the General Advisory Dataset

Fish mercury data from historic electronic files for Lake Champlain and “Inland lakes and ponds” (including rivers and streams) were combined into one database. The technical details of specific analyses and the complete dataset are available in Appendix 1 and Appendix 2, respectively. Most of these samples were single skin-off fillet, however 48 samples were from a composite of between two to six fish. The fish tissue mercury dataset used for the general fish advisory has 1,348 harvest-sized samples from 50 waterbodies and includes data for 21 species.

## Mercury Concentrations in Fish Species

Fish mercury concentrations in milligrams per kilogram (mg/kg) for each species are shown from low to high mercury in Table 1. Mercury was detected in every fish sampled. Having more samples for each species improves confidence in the estimate of the average mercury concentration. Ten species of fish had more than 10 samples, providing enough samples to calculate the 95<sup>th</sup> percent upper confidence limit (95<sup>th</sup> UCL) of the arithmetic mean<sup>10</sup>. EPA recommends using the 95<sup>th</sup> UCL for environmental health risk assessment.<sup>11</sup> Species with limited sample numbers (bluegill, rainbow smelt, white crappie, rock bass, black crappie, rainbow trout, brook trout, white sucker, American eel, Atlantic salmon), are grouped with other species in their trophic level for safe fish-eating advice.

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<sup>10</sup> Supplemental Guidance to RAGS: Calculating the Concentration Term  
<https://rais.ornl.gov/documents/UCLsEPASupGuidance.pdf>

<sup>11</sup> Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites <https://www.epa.gov/sites/production/files/2016-03/documents/upper-conf-limits.pdf>

**Table 1. Vermont Fish Mercury Concentrations by Species**

Fish Species	Number of Samples	Fish Mercury Concentration (mg/kg) Average (range)	Mercury Standard Deviation	Fish Length (inches) Average (range)
White Sucker	4	0.05 (0.03-0.12)	0.05	15 (13-18.6)
Brown Trout	20	0.08 (0.03-0.39)	0.08	9.6 (6.2-15.5)
Brown Bullhead	23	0.09 (0.03-0.21)	0.06	9.1 (6.3-13.6)
Rainbow Trout	5	0.1 (0.03-0.22)	0.08	9.8 (6.9-15.4)
Black Crappie	3	0.11 (0.09-0.12)	0.02	8.7 (8-9.6)
Brook Trout	15	0.12 (0.03-0.35)	0.10	8.6 (5.3-12.6)
White Crappie	1	0.12 (0.12-0.12)	-	8.9 (8.9-8.9)
Pumpkinseed	20	0.12 (0.05-0.3)	0.07	6.5 (5.3-7.2)
Rainbow Smelt	1	0.14 (0.14-0.14)	-	6.6 (6.6-6.6)
Bluegill	1	0.15 (0.15-0.15)	-	7.5 (7.5-7.5)
Yellow Perch	465	0.18 (0.01-1.3)	0.15	8.2 (5.5-14.3)
Atlantic Salmon	7	0.2 (0.09-0.55)	0.17	18.9 (15.7-21.8)
White Perch	196	0.25 (0.03-1.02)	0.19	9.3 (5-13.5)
Largemouth Bass	66	0.31 (0.09-1.2)	0.19	14.7 (10.5-19.8)
Rock Bass	2	0.35 (0.31-0.39)	0.06	7.9 (7.2-8.5)
Northern Pike	56	0.37 (0.08-0.92)	0.20	25.5 (20.1-39)
American Eel	6	0.45 (0.17-0.81)	0.22	32.5 (29.8-34)
Lake Trout	133	0.5 (0.03-1.25)	0.22	26.3 (14.1-33)
Chain Pickerel	11	0.51 (0.12-1.08)	0.25	17 (12-20.2)

Smallmouth Bass	248	0.63 (0.07-1.96)	0.35	16.9 (10.2-21)
Walleye	125	0.81 (0.17-2.04)	0.42	22.9 (18.3-29.5)

Note: Fish mercury statistics are based on a subset of the fish caught in Vermont waters, excluding the fish from the Connecticut and Deerfield River reservoirs and fish smaller than harvest length.

Because mercury bioaccumulates in the food chain, fish species with the highest mercury concentrations are often long-lived, large predatory fish that feed on other fish. The distribution of mercury among fish species in Vermont is consistent with known mercury bioaccumulation patterns (Vander Zanden et al., 1997). Mercury concentrations increased with trophic level with the highest mercury concentrations found in species that eat other fish such as walleye, smallmouth bass and lake trout, in patterns similar to the mercury distribution in fish species reported in other studies (Wentz et al., 2014, Depew et al., 2013).

## Safe Fish-Eating Guidelines

Safe eating guidelines are established for people to limit or avoid eating certain species of fish caught from specific waterbodies or types of waterbodies due to potential contamination. The safe fish-eating guidelines are based on the levels of mercury in the fish species. Of the many toxic effects mercury may induce in humans, the most sensitive effect is harm to an unborn baby or a young child's developing nervous system. Some groups of people: those who are pregnant or nursing, of childbearing age and children under the age of seven, are at a greater health risk from mercury exposure than others. In this report, the groups of people with higher risk from mercury exposure are referred to as the “sensitive population”.

## Fish Mercury Screening Level Calculation

Health evaluates potential health risk from mercury exposure by comparison of the exposure level with a toxicological reference dose (RfD). An RfD is an estimate of a daily oral exposure that is likely to be without any appreciable risk of adverse health effects. The EPA's Integrated Risk Information System (IRIS) RfD for methylmercury was derived to be protective for the developing nervous system of the fetus and young child (EPA 2001a). Health used the IRIS RfD for methylmercury, 0.0001 mg/kg-day to calculate the meal limits for sensitive populations: people who are or may become pregnant, are breastfeeding and children under age seven. For the general population (children over age six and other adults), Health used an alternative RfD based on neurological impairment in adults (0.0003 mg/kg-day) to calculate meal limits (EPA 2001b).

Health uses the RfD to calculate fish mercury screening levels to recommend risk-based meal limits as described in the EPA "Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories" (EPA 2000)<sup>12</sup>, as shown in **Equation 1**. Fish meal portion sizes were obtained from "Technical Information on Development of FDA/EPA Advice about Eating Fish for Those Who Might Become or Are Pregnant or Breastfeeding and Children Ages 1-11 Years" (FDA 2021).<sup>13</sup> Screening levels were calculated for a consumption rate of one meal per week using a meal size of eight ounces (0.227 kg, uncooked weight) for an adult, and four ounces (0.113 kg) for a child.

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<sup>12</sup> Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1: Fish Sampling and Analysis Third Edition (November 2000) <https://www.epa.gov/fish-tech/epa-fda-fish-advice-technical-information>

<sup>13</sup> FDA Technical Information on Development of FDA/EPA Advice about Eating Fish <https://www.fda.gov/food/environmental-contaminants-food/technical-information-development-fdaepa-advice-about-eating-fish-those-who-might-become-or-are>

## Equation 1. Fish Mercury Screening Level

$$\text{Fish Mercury Screening Level } \left(\frac{\text{mg}}{\text{kg}}\right) = \frac{\text{RfD (mg/kg - day)} * \text{Body Weight (kg)}}{\text{Fish Consumption Rate } \left(\frac{\text{kg}}{\text{day}}\right)}$$

To derive the advice for the sensitive population, screening levels were calculated for each age group from one to six years old and for a woman of childbearing age. The fish ingestion rate and body weight that provided the lowest screening value was selected to determine consumption advice for the sensitive population. The lowest screening level, 0.15 mg/kg, is for a child aged six, using an estimated fish consumption rate of four ounces per week (FDA 2021) and the US CDC recommended average bodyweight for female children aged five to six.<sup>14</sup> For comparison, the fish tissue screening level for one (eight ounce) meal per week for a 62 kg woman of childbearing age is 0.19 mg/kg. For the general population using the RfD of 0.0003 mg/kg-day and a bodyweight of 70 kg, the eight-ounce meal per week screening level is 0.64 mg/kg.

This means that a person in the sensitive population may eat one fish meal per week if the fish mercury concentration is 0.15 mg/kg or below. At a mercury concentration greater than 0.15 mg/kg a person in the sensitive population should eat that fish less often according to the Safe Fish-Eating Guidelines.

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<sup>14</sup> CDC's Anthropometric Reference Data for Children and Adults: United States, 2007–2010 (Oct 2012) - Table 1, based on data from National Health and Nutrition Examination Surveys (NHANES)  
[https://www.cdc.gov/nchs/data/series/sr\\_11/sr11\\_252.pdf](https://www.cdc.gov/nchs/data/series/sr_11/sr11_252.pdf).

**Table 2. Inputs for Equations 1 and 2**

	Value	Units	Source
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**Sensitive Population**

Reference Dose	0.0001	mg/kg-day	EPA 2001a
Body Weight	23.6	kg	CDC 2012
Fish Consumption Rate	0.113 16.2	kg/week g/day	One 4-ounce meal/week

**General Population**

Reference Dose	0.0003	mg/kg-day	EPA 2001a
Body Weight	70	kg	CDC 2012
Fish Consumption Rate	0.227 32.4	kg/week g/day	One 4-ounce meal/week

## Meals per Month Based on Mercury Concentrations

Safe fish-eating guidelines are established so people can eat fish without concern for too much mercury exposure. The 95<sup>th</sup> UCL of the mean mercury concentration in each fish species was used for the safe fish-eating guidelines. Species with a 95<sup>th</sup> UCL and fish mercury screening levels are shown in **Figure 1**.

**Figure 1. Mercury in Vermont Fish Species by Advice Category**

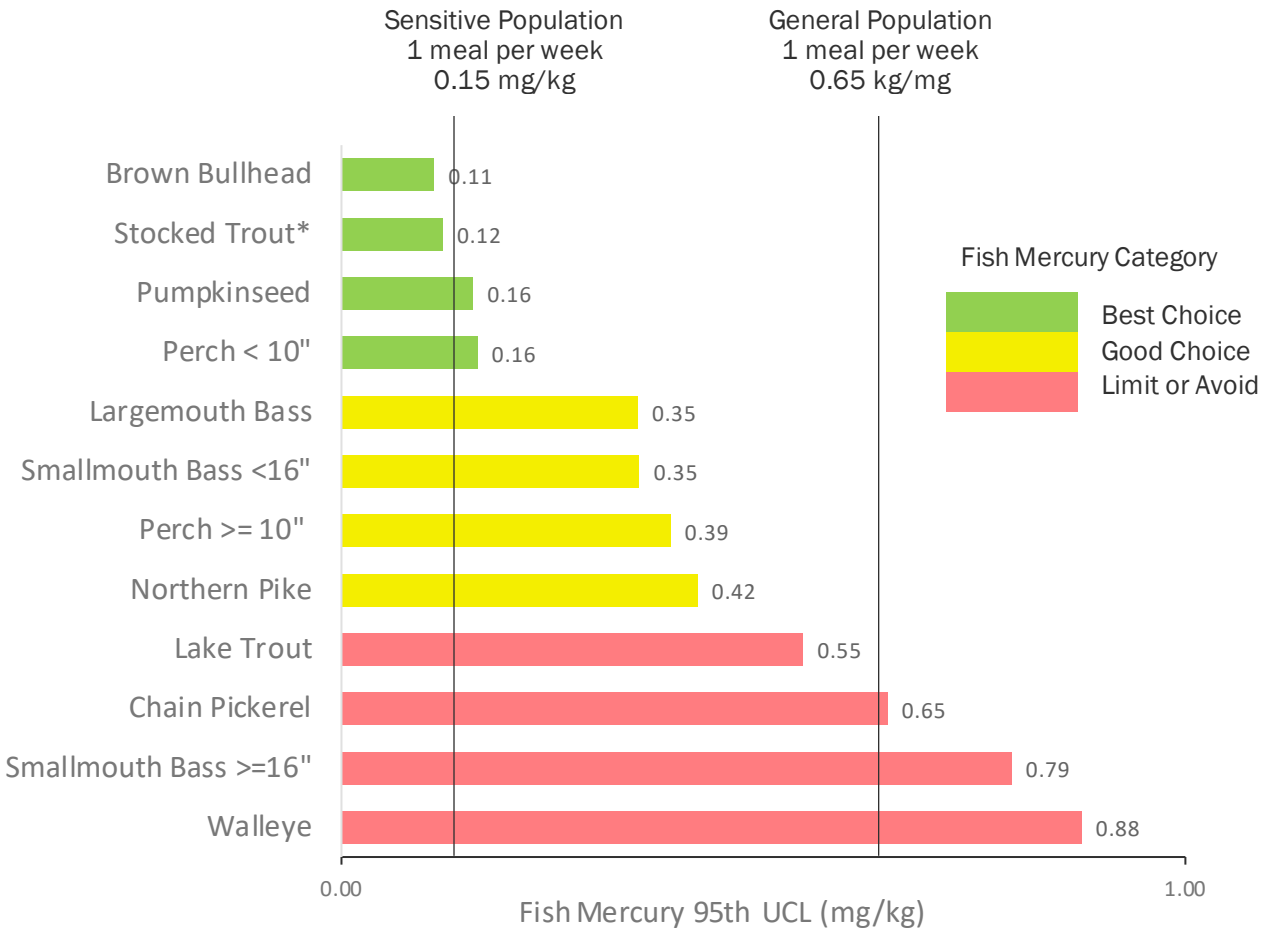


Figure 1. Vermont fish species mercury 95th UCL of mean, used for safe fish-eating guidelines.

\* Please see Stocked Trout section for discussion.

The number of meals per month that are safe to eat, presented in Table 3, were calculated using **Equation 2** and the 95<sup>th</sup> UCL of the average mercury concentration for each species. The recommended number of meals per month are divided into three categories to simplify communication, consistent with the EPA/FDA fish risk

communication strategy<sup>15</sup>. The meals per month were rounded to fit within one of the three meal per month categories for the sensitive and the general populations.

## Equation 2. Fish Meals per Month Guidelines <sup>16</sup>

$$Meals\ per\ month = \frac{RfD \left( \frac{mg}{kg\ day} \right) \times Body\ Weight\ (kg)}{Tissue\ Concentration \left( \frac{mg}{kg} \right)} \times \frac{30.4\ day}{month} \div \frac{kg}{Meal}$$

Table 3. Fish Mercury and Recommended Safe Fish-Eating Guidelines

Fish Species	Fish Mercury (mg/kg) 95 <sup>th</sup> % UCL	Sensitive Population Meals/Month Calculated	Sensitive Population Meals/Month Guideline	General Population Meals/Month Calculated	General Population Meals/Month Guideline
Brown Bullhead	0.11	5.8	4	26	>8
Brown Trout	0.16	4.1	4	18	>8
Yellow, White Perch <10"	0.16	3.9	4	17	>8
Smallmouth Bass <16"	0.34	1.9	1	8.3	6
Largemouth Bass	0.35	1.8	1	8.0	6

<sup>15</sup> <https://www.fda.gov/food/environmental-contaminants-food/technical-information-development-fdaepa-advice-about-eating-fish-those-who-might-become-or-are>

<sup>16</sup> U.S. EPA Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories “CR (kg/d) = RfD x BW / Fish Concentration” (EPA equation 3-3) with conversion of CR from kg/day to meals/month



Northern Pike	0.42	1.5	1	6.7	6
Yellow, White Perch >=10"	0.39	1.6	1	7.2	6
Lake Trout	0.55	1.2	0	5.1	4
Chain Pickerel	0.65	1.0	0	4.4	4
Smallmouth Bass >=16"	0.79	0.8	0	3.5	4
Walleye	0.88	0.7	0	3.2	4

Note: Data shown are for the subset of Vermont fish mercury data that was used to support the safe fish-eating guidelines. Meals per month for the Sensitive and General populations calculated with the 95<sup>th</sup> UCL using Equation 2.

## Waterbody-Specific Advisories

The Vermont fish mercury dataset was evaluated to support the waterbody-specific advisories for Lake Champlain and the Deerfield and Connecticut River reservoirs.

### Lake Champlain

Approximately two-thirds of the fish mercury data in the Vermont database is from Lake Champlain. The other waterbodies combined have only about six species with enough mercury data to make a statistical comparison. The best represented species is yellow perch. Small yellow perch from Lake Champlain are about 20% lower in mercury than those from other lakes and ponds. In general, waterbodies with lower-than-average fish mercury are not discernable within the Vermont fish mercury dataset. Safe Fish-Eating Guidelines do not distinguish the fact that some waterbodies may have less mercury in their fish. Yellow perch from Lake Champlain have slightly less mercury than the statewide average, however the meal limits still fall in the same categories. Because the Statewide Safe Fish-Eating Guidelines now limit smallmouth bass to the same advice

as for Lake Champlain, a waterbody-specific limit for consumption of smallmouth bass from Lake Champlain is no longer necessary. The waterbody-specific advice to restrict consumption of lake trout from Lake Champlain due to PCB contamination remains in effect.

## Deerfield River and Connecticut River Reservoirs

As discussed in the Fish Mercury Data Analysis section, the Deerfield and Connecticut Rivers have hydroelectric reservoirs, which provide environmental conditions that are sometimes conducive to fish mercury bioaccumulation.<sup>17</sup> Fish from these waterbodies are tested for mercury by Great River Hydroelectric on a five-year basis. Concentrations of mercury in the indicator species yellow perch and smallmouth bass and the waterbody-specific Safe Fish-Eating guidelines are shown in **Table 4**.

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### Deerfield River

Of the data available for the Deerfield River's chain of reservoirs (Grout Pond and the Somerset, Harriman, Sherman and Searsburg Reservoirs), only three species had enough samples to compute a 95<sup>th</sup> UCL: brown trout, yellow perch and smallmouth bass. For smallmouth bass the 95<sup>th</sup> UCL mercury concentration was more than twice the state average, yellow perch mercury concentrations were more than four times the state average.

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<sup>17</sup>Deerfield River & Lower Connecticut River Tactical Basin Plan  
[https://dec.vermont.gov/sites/dec/files/WID/B12\\_Public\\_DRAFT\\_2019-12-10.pdf](https://dec.vermont.gov/sites/dec/files/WID/B12_Public_DRAFT_2019-12-10.pdf)

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## Connecticut River

Vermont and New Hampshire coordinated to have consistent fish consumption advice for the 15 Mile Falls Chain along the Connecticut River<sup>18</sup>. Mercury concentrations in fish from these reservoirs are presented in Table 5. In the Comerford and Moore Reservoirs, mercury concentrations in smallmouth bass were almost twice the state average; small yellow perch were four times higher than the state average. Both New Hampshire and Vermont restrict sensitive populations from eating most fish from the Comerford and Moore Reservoirs, the general population may eat two meals per month.

There is relatively little fish mercury data to support the waterbody-specific advice for the McIndoes Reservoir (14 smallmouth bass, five yellow perch, as shown in Table 4). New Hampshire no longer has a waterbody-specific advisory for the McIndoes Reservoir<sup>19</sup>. Based on the mercury concentrations in the yellow perch and smallmouth bass from the McIndoes Reservoir, the statewide advisory is protective for consumption of fish from the McIndoes Reservoir and a waterbody-specific advisory is not necessary.

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<sup>18</sup>Getting the Mercury Out of Vermont's Environment  
[https://dec.vermont.gov/sites/dec/files/wmp/SolidWaste/Documents/ACMP\\_Report\\_2001.pdf](https://dec.vermont.gov/sites/dec/files/wmp/SolidWaste/Documents/ACMP_Report_2001.pdf)

<sup>19</sup> New Hampshire Fish Consumption Guidelines  
<https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/ard-ehp-25.pdf>

**Table 4. Meals per Month Guidelines for the Deerfield and Connecticut River Reservoirs**

	# Samples	95 <sup>th</sup> UCL Mercury (mg/kg)	Sensitive Population Calculated Meals/Month	Sensitive Population Statewide	Sensitive Population Waterbody-Specific	General Population Calculated Meals/Month	General Population Statewide	General Population Waterbody-Specific
<b>Deerfield River Chain</b>								
Smallmouth Bass <16 inches	22	1.30	0.49	1	0	2.2	6	2
Yellow Perch <10 inches	10	0.79	0.80	2	0	3.6	>8	2
<b>Connecticut River</b>								
<b>Commerford &amp; Moore Reservoirs</b>								
Smallmouth Bass <16 inches	96	1.01	0.63	1	0	2.8	6	2

Yellow Perch <10 inches	47	0.65	0.97	4	0	4.3	>8	2
White Suckers	30	0.402	1.58	4	0	7.0	>8	2

### McIndoes Reservoir

Smallmouth Bass <16 inches	11	0.745	0.85	1	1	3.8	6	6
Yellow Perch <10 inches	5	0.31	2.04	4	4	9.1	>8	>8

### Fish Mercury Dataset

Smallmouth Bass <16 inches	175	0.35	1.79	1	-	8.0	6	-
Yellow Perch <10 inches	532	0.16	3.96	4	-	18	>8	-

## Other Waterbody-Specific Advisories

The fish mercury dataset used to develop the Safe Fish-Eating Guidelines included fish from Vermont's rivers, streams, lakes and ponds. Using a waterbody inclusive dataset allowed the greatest number of samples and increased confidence in the average estimations. The many assessable fishing spots in Vermont have not been sampled for fish mercury, therefore the average mercury for each fish species is used for the Safe Fish-Eating Guidelines. The Safe Fish-Eating Guidelines do not identify waterbodies that may have some fish with lower-than-average mercury concentrations. Vermonters can contact Health to discuss what data are available for a specific waterbody and what that might mean for their personal risk.

## Advisories for Polychlorinated Biphenyl Compounds in Fish

Vermont has two waterbodies with specific advisories for potential PCB contamination, Lake Champlain and the Hoosic River, based on contamination levels reported by New York and Massachusetts, respectively.

The PCB fish consumption limits apply to all populations:

- Lake Champlain - Do not eat: Lake Trout longer than 25 inches
- Hoosic River - Do not eat: All fish

These advisories have been listed with EPA since 2007 and will be maintained until additional data allows a reassessment of the fish contaminant concentrations.

## Advisories for Stocked Trout

The Vermont Fish & Wildlife Department's fish hatcheries raise and release more than a million fish each year to restore fish populations and enhance angling opportunities.

Many of Vermont lakes, ponds and rivers commonly receive 1,000 or more harvest-sized trout each year.

## Exclusion of Lake Trout from Stocked Trout Advisory

While most trout are low in mercury, one species: lake trout, are an exception. Lake trout are a long-lived large piscivorous fish with relatively high mercury concentrations when compared to other trout species (Table 1). EPA reported that the rate of mercury accumulation in lake trout increases when the lake trout become large enough to switch from a diet of invertebrates to a diet of forage fish (EPA 1999). The average mercury concentration of 127 lake trout was 0.51 mg/kg, the maximum was 1.25 mg/kg.

Because lake trout have much higher mercury concentrations than their younger cold water trout cousins, the general discussion of the trout for the purposes of safe fish-eating guidelines excludes lake trout.

## Stocked Trout Advisory

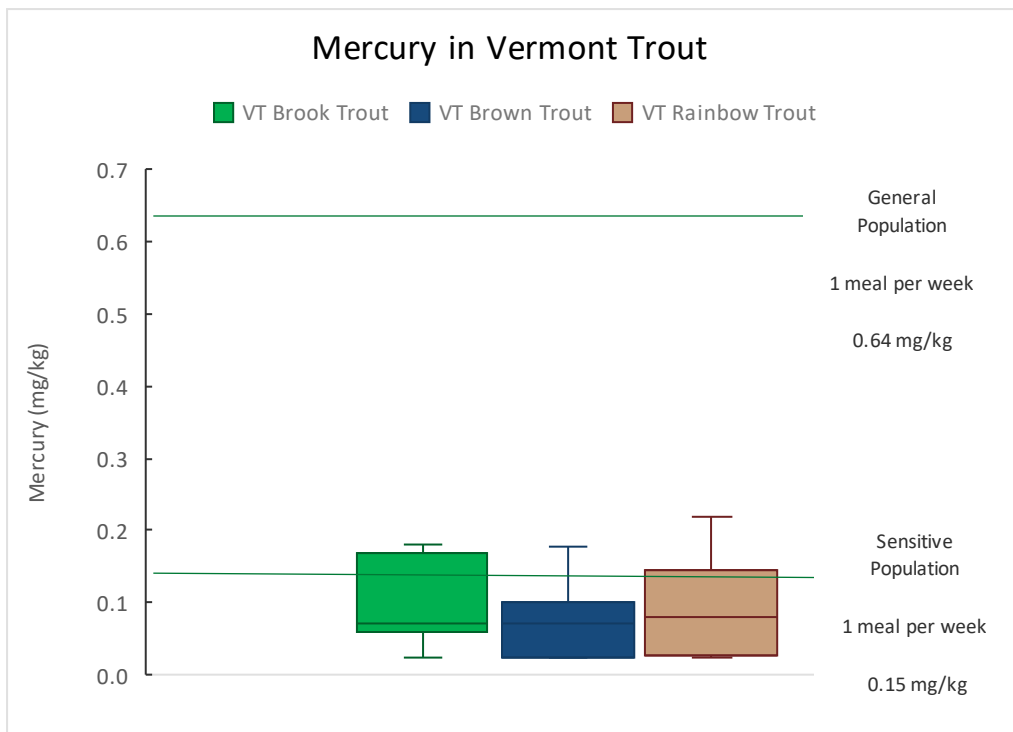
In general, trout raised in a hatchery do not face the same dietary exposure to mercury as wild trout.<sup>20</sup> Hatchery fish grow quickly and even trout released as trophy size specimens may be low in mercury. In contrast to hatchery-raised trout, wild trout may take five years to reach harvest size eating insects and macroinvertebrates, graduating to larger feed as they grow. This results in wild trout having higher mercury concentrations than stocked trout. However, from the data that has been collected, it is rare to find a trout in Vermont or New Hampshire with a concerning level of mercury.

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<sup>20</sup> Massachusetts Public Health Freshwater Fish Consumption Advisories – 2023  
<https://www.mass.gov/doc/public-health-freshwater-fish-consumption-advisories-2023-0>

Concentrations of mercury in trout are shown in **Figure 2**. Mercury concentrations for Vermont brown trout, rainbow trout and brook trout were 0.086, 0.093 and 0.115 mg/kg, respectively. The data show that the average trout concentrations are below the one meal per week screening level for the General population (0.64 mg/kg), and well below the 0.64 mg/kg screening level for the general population.

**Figure 2. Mercury in Vermont Trout**





Due to the small number of trout samples from Vermont, the three trout species that we have data for were combined for statistical power.<sup>21</sup> All together there are 44 samples with an average mercury concentration of 0.097 mg/kg and a 95<sup>th</sup> UCL of 0.0.119 mg/kg. The 95<sup>th</sup> UCL corresponds to a Safe Fish-Eating Guideline of 5.32 meals per month for the General population and 23.7 meals per month for the general population. The EPA/FDA commercial fish consumption advisory for freshwater trout is based on a 95<sup>th</sup> UCL mercury concentration of 0.12 mg/kg and recommends freshwater trout as a “Best Choice”.<sup>22</sup> Similarly, the New Hampshire fish mercury advice recommends the general population limit rainbow and brown trout to one meal per week, others can eat six meals per week.<sup>23</sup>

The New Hampshire brook trout advice follows the statewide advisory general population at 1 meal per month, general population at four meals per month.

The trout data suggest that safe fish-eating guidelines for stocked trout be considered differently from other wild fish in the statewide mercury advisory, with clear messaging that the risk of mercury exposure from stocked trout is very low compared to any other freshwater fish. The Vermont Fish & Wildlife Department lists stocking locations and dates on their website. Checking the Fish & Wildlife stocking schedule will help people know when and where freshly stocked trout can be easily caught. The Safe Fish-Eating Guidelines for stocked trout encourages Vermonters to utilize this resource and increase their consumption of these low mercury fish for the many health benefits.

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<sup>21</sup> Only samples with length data were included in this assessment.

<sup>22</sup> FDA Technical Information on Development of FDA/EPA Advice about Eating Fish <https://www.fda.gov/food/environmental-contaminants-food/technical-information-development-fdaepa-advice-about-eating-fish-those-who-might-become-or-are>

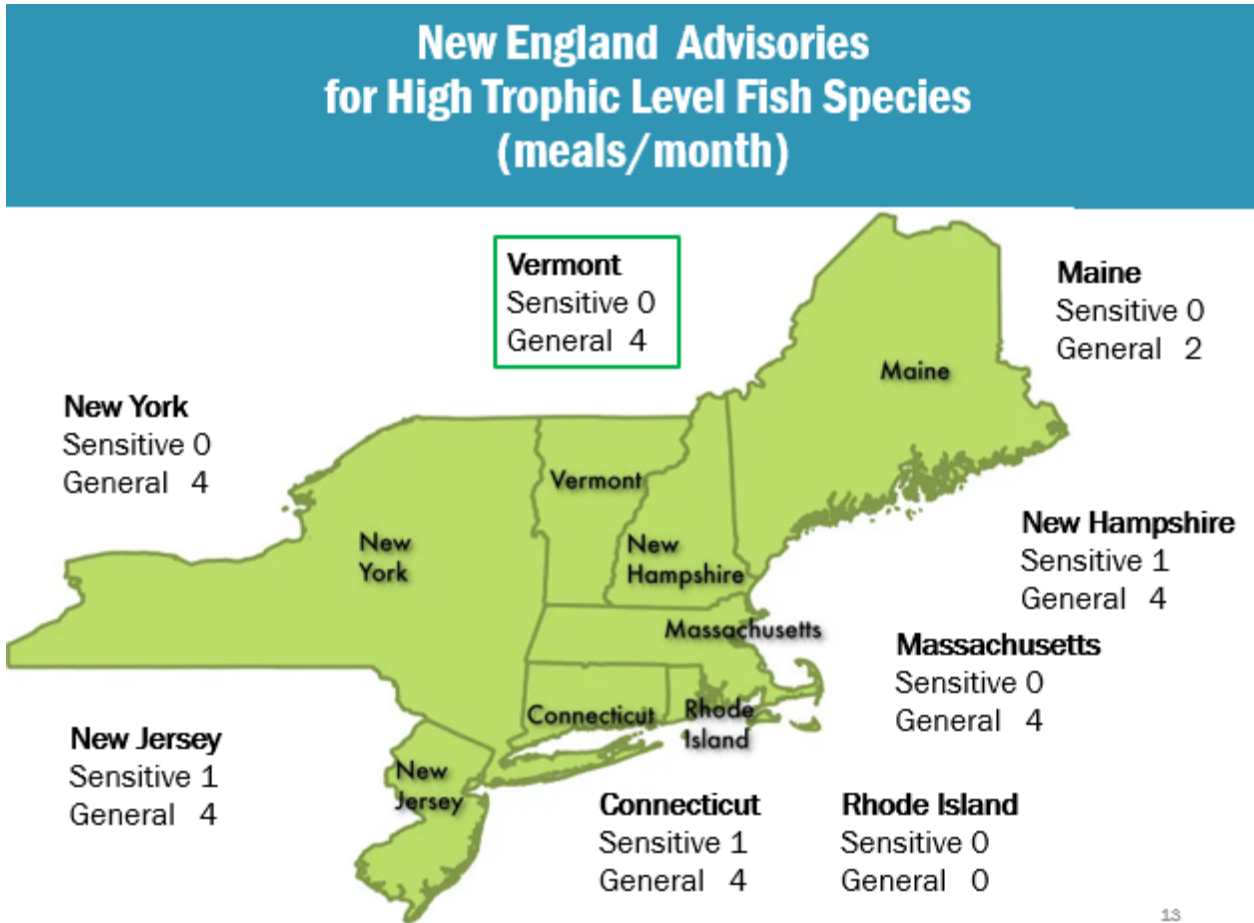
<sup>23</sup> New Hampshire Fish Consumption Guidelines <https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/ard-ehp-25.pdf>

The Vermont Safe Fish-Eating Guidelines for stocked trout recommends that sensitive populations may have four meals per month, and the general population may have more than eight meals per month.

## Comparison to Other States Fish Mercury Advisories

When States share waterbodies, it is important to coordinate fish eating advice to ensure clear messaging (Cleary et al., 2021). Mercury-based meal limits for the highest trophic level fish in the New England states are shown in Figure 3). New York (Lake Champlain) has the sensitive population consume zero high trophic level fish, a category that includes largemouth bass, northern pike and pickerel, and yellow perch over 10 inches. In New Hampshire, limits are one meal per month for the sensitive population and four meals per month for the general population. In addition, New Hampshire limits the length of high trophic level species to less than 12 inches. The state-wide advisories for Maine and Massachusetts are for sensitive populations to not consume any wild fish (any species). Massachusetts and New York rely extensively on waterbody-specific advisories, having 240 and 160 current waterbody-specific assessments, respectively. Maine, New Hampshire, and Vermont have limited waterbody-specific advice and use a statewide advisory approach. Because Health used the EPA approach to establish the safe fish-eating guidelines, there is general agreement in fish consumption advice between Vermont and other New England states.

**Figure 3. Comparison of Fish Consumption Advisories for New England Species**



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# Appendix 1

All data for mercury in Vermont fish, as submitted to the FCMC for consideration in the safe fish-eating guidance, is available in Microsoft Excel workbook format. The workbook contains the fish mercury data that has been submitted (fish samples collected between 1993-2017). No original lab reports or field records are available. The original data sources for inland lakes & ponds (excluding reservoirs which originated in separate files), and Lake Champlain were combined. Various subsets of the data were used for specific analyses as described in the text.

## Fish Excluded from Vermont Fish Mercury Dataset Due to Short Length

For the mercury safe fish-eating guidelines, fish smaller than the minimum harvest length were excluded. Table A1-1 shows a summary of fish that were excluded from fish mercury safe fish-eating guideline dataset due to short length.

Table A1-1. Fish Excluded from Vermont Fish Mercury Dataset Due to Short Length

Fish Species	Number of Samples Included	Average Length (inches)	Minimum Harvest Length (inches)
Black Crappie	1	7.2	8
Lake Trout	6	15.7	18
Largemouth Bass	3	9.9	10
Northern Pike	3	19.1	20

Smallmouth Bass	4	8.8	10
Walleye	32	15.3	18

## Length Limits for Perch

There is a positive relationship between mercury concentration and fish length for some long-lived predatory species (Scudder Eikenberry et al., 2015). Vermont has two species of fish with length specific advisories; yellow perch and smallmouth bass. Below is an evaluation of the data that supports the length limits for the Vermont safe fish-eating advice.

Yellow perch are the most sampled fish species in Vermont: the fish advisory dataset contains mercury concentrations for 464 yellow perch. Although white perch are a distinct species of fish, both perch species are at a similar trophic level of the food chain and have similar mercury bioaccumulation. The 10-inch length advice for perch is supported because the average mercury concentration in perch greater than 10 inches long is almost twice that of perch in the less than 10-inch category. Table A1-2 shows the average mercury concentrations and recommended meal limits for perch based on length.

Figure A1. Mercury Concentrations in Yellow and White Perch Fillet by Length

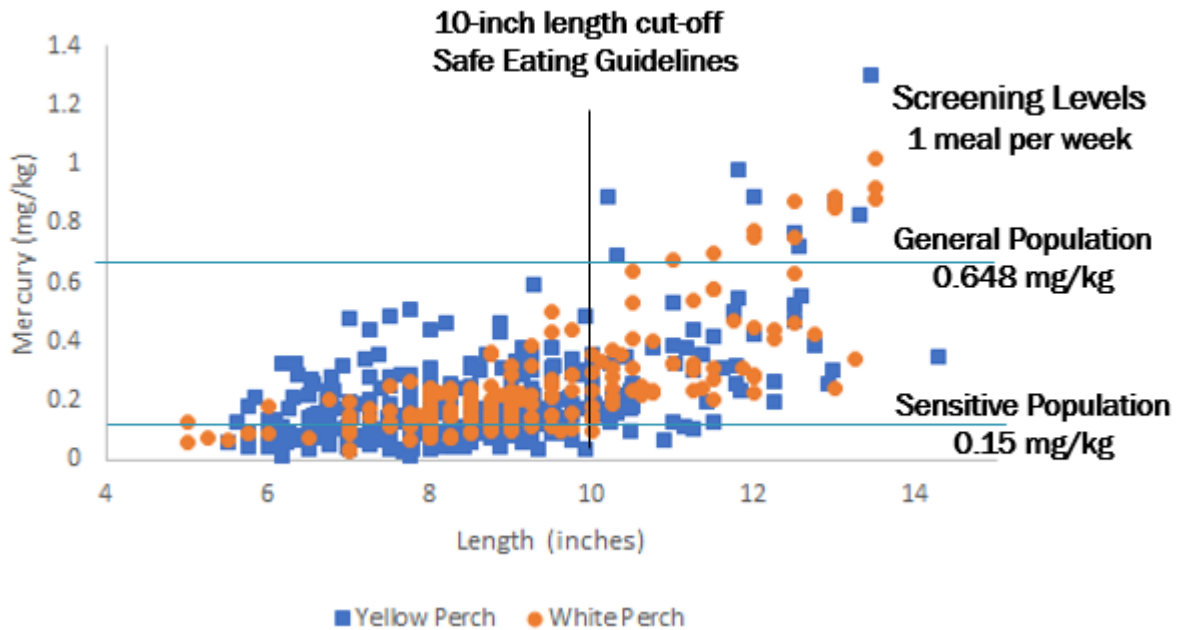


Table A1-2. Mercury in Yellow & White Perch by Length

Length	Number of Samples	Average Length (inches)	Fish Mercury (mg/kg) 95 <sup>th</sup> UCL	Sensitive Population Meals/Month Calculated	Sensitive Population Meals/Month Guideline	General Population Meals/Month Calculated	General Population Meals/Month Guideline
< 10 inches	532	7.9	0.16	4.1	4	18	>8
>= 10 inches	129	11.3	0.43	1.6	1	7	6



Table A1-3. Mercury in Smallmouth Bass by Length

Length	Number of Samples	Average Length (inches)	Fish Mercury (mg/kg) 95 <sup>th</sup> UCL	Sensitive Population Meals/Month Calculated	Sensitive Population Meals/Month Guideline	General Population Meals/Month Calculated	General Population Meals/Month Guideline
< 16 inches	77	13	0.34	1.86	1	8.28	6
>= 16 inches	175	18.3	0.79	0.80	0	3.55	4